Original Research Article

"Field efficacy of insecticides and botanicals for management of spotted stem borer (*Chilopartellus*) on maize (*Zeamays* L.)"

Comment [sa1]: Efficacy of synthetic and biocompatible insecticides for ..... in field condition.

Abstract:

The field investigation took place during the *Kharif* seasons of 2021 and 2022 at the Central Research Farm (CRF) of Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh, India. The experiment was organized in a Randomized Block Design, comprising twelve treatments, each replicated thrice. The treatments included Chlorantraniliprole 18.5 SC (0.5 ml/l), Lambda cyhalothrin 2.5% EC (10 ml/l), Thiamethoxam 25 WG (10 gm/kg), Profenophos 50 EC (3ml/l), Cypermethrin 10 EC (4 ml/l), Neem oil 3% (30 ml/l), *Verticilliumlecani* 1.15 WP (15 ml/l), Spinosad 45 SC (0.3 ml/l), Emamectin benzoate 5 SG (0.40 gm/kg), Indoxacarb 15.8 EC (1.5 ml/l), NSKE 5% (50 ml/l), and control plot. The results showed that the maize *chilopartellus*lowest larval population during the *Kharif* seasons of both 2021 and 2022 was identified inEmamectin benzoate 5 SG (2.24), (0~~.82~~) and (~~3.61~~), (2.33) followed by Chlorantraniliprole 18.5 SC (2.41), (1.01) and (~~3.82~~), (2.46), Indoxacarb 15.8 EC (2.53), (1.13) and (3.92), (2.55), Thiamethoxam 25 WG (2.66), (1.26) and (3.99), (2.66), Lambda cyhalothrin 2.5% EC (2.73), (1.33) and (4.06), (~~2.73~~) andSpinosad 45 SC (2.86), (1.46) and (4.12), (3.79). In this Profenophos 50 EC (~~2.93~~), (1.53) and (4.19), (2.86),Cypermethrin 10 EC (2.99), (1.59) and (4.32), (2.99), *Verticilliumlecani*1.15 WP (~~3.06~~), (~~1.66~~) and (4.39), (3.06), Neem oil 3% (3.13), (1.73) and (4.46), (3.13),NSKE 5% (3.19), (1~~.79~~) and (4~~.55~~), (~~3.24~~) is found to be least effective than all the treatments and is significantly superior over the control (4~~.99~~), (~~6.19~~) and (6.40), (7.19).

Comment [sa2]: Concentration and manufacturing company should be included in a separate table.

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Key words:*Chilopartellus*, Efficacy, insecticides, Maize.

Introduction:

Maize, also known as corn, is a widely cultivated cereal grain that is an important staple food in many parts of the world. It is a highly versatile crop that is used for a variety of purposes, including human consumption, animal feed, and industrial products. Maize is grown in diverse agroecological zones, ranging from tropical to temperate regions, and is produced in large quantities globally. According to the Food and Agriculture Organization (FAO), maize is the third most important cereal crop in the world, after wheat and rice, and is grown on an estimated 191 million hectares globally, with a total production of 1.14 billion tonnes in 2021. Maize is an important source of carbohydrates, protein, fiber, and other essential nutrients, and plays a critical role in food security and livelihoods for millions of people worldwide. **FAOSTAT (2021).**

The nutritious cereal grain known as maize, or corn, is a great source of vitamins, minerals, fibre, protein, and carbs. One cup of cooked yellow maize contains 123 calories, 26 grammes of carbohydrates, 3 grammes of protein, 2.5 grammes of fibre, and a number of vital vitamins and minerals, including vitamin C, vitamin B6, potassium, magnesium, and phosphorus, according to the United States Department of Agriculture (USDA). Maize is also high in antioxidants and has been associated with a number of health advantages, including better digestion, a decreased risk of chronic illnesses, and better heart health **(source: USDA).**

The average production of maize per hectare in the world increased to 5.9 metric tonnes in 2019 from 4.4 metric tonnes in 2000. These increases in maize productivity have supported economic growth and rural development in many nations while also helping to fulfil the rising demand for food, feed, and industrial purposes. (Source: retrieved March 31, 2023 from FAOSTAT, "Maize - Production, Quantity"). With an output of 28.98 million tonnes of maize in 2020–21, India is one of the top producers in the world **(Ministry of Agriculture and Farmers Welfare, 2021).** Most Indian states cultivate maize, with Karnataka, Andhra Pradesh, Telangana, Bihar, Uttar Pradesh, and Rajasthan being the top producers **(Directorate of Maize Research, 2021)**. With an average yield of 2.93 tonnes per hectare in 2020-21 compared to 2.80 tonnes per hectare in 2019–20, maize productivity in India has been continuously rising over time **(Ministry of Agriculture and Farmers Welfare, 2021).** Use of more advanced technology, including as hybrid cultivars, high-

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density planting, and enhanced crop management techniques, is responsible for this rise in production **(Directorate of Maize Research, 2021).**

In many regions of Africa and Asia, the Spotted Stem Borer (*Chilopartellus*), a serious pest of maize crops, reduces yields significantly. Depending on where the pest is in its life cycle, different harm might be produced. Early on in the larvae's development, the plant's whorl and leaves sustain the majority of the damage, which stunts the plant's growth and reduces photosynthesis. But, when the larvae grow older, they begin to dig into the stem, severely harming the vascular tissue, which causes wilting and ultimately plant death. According to studies, the yield losses due by the pest's damage might range from 10% to 70%. **(Sisay *et al.*, 2019 and Sharma *et al.*, 2017).** To lessen the harm this insect causes, efficient control methods are required, such as the adoption of resistant maize cultivars and integrated pest management techniques.

Materials and Methods:

The study was carried out during the *Kharif* seasons of 2021 and 2022 at the Central Research Farm (CRF) of SHUATS, Prayagraj, Uttar Pradesh, India. The experimental design employed was a Randomized Block Design with twelve treatments, each replicated three times. The plot size was (2m×2m) with a spacing of (60×20cm). The recommended package of practices,excluding plant protection, was followed.The treatments included Chlorantraniliprole 18.5 SC (0.5 ml/l), Lambda cyhalothrin 2.5% EC (10 ml/l), Thiamethoxam 25 WG (10 gm/kg), Profenophos 50 EC (3ml/l), Cypermethrin 10 EC (4 ml/l), Neem oil 3% (30 ml/l), *Verticilliumlecani* 1.15 WP (15 ml/l), Spinosad 45 SC (0.3 ml/l), Emamectin benzoate 5 SG (0.40 gm/kg), Indoxacarb 15.8 EC (1.5 ml/l), NSKE 5% (50 ml/l), and a control.

Two sprays were carried out at interval of 15 days during the experiments to assess the effectiveness of insecticides when the *chilopartellus* larval population. Five plants were randomly selected in each treatment and observation was taken one day before spraying application three, seven and fourteen-day spraying. Foliar and granular insecticides were applied at their recommended doses at economic threshold level (ETL=10% infestation) **(Iqbal *et al.*, 2017).**

RESULTS~~AND DISCUSSION~~

Efficacy of *ChilopartellusKharif* 2021 (First Spray)

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Three Days After Spraying: The data on the larval population of spotted stem borer on three days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (1.53) followed by T_1 Chlorantraniliprole 18.5 SC (1.66), T_{10} Indoxacarb 15.8 EC (1.93), T_3 Thiamethoxam 25 WG (2.20), T_2 Lambda cyhalothrin 2.5% EC (2.26) and T_8 Spinosad 45 SC (2.33). In this T_4Profenophos 50 EC (2.53), T_5 Cypermethrin 10 EC (2.80), T_7*Verticilliumlecani*1.15 WP (2.93), T_6 Neem oil 3% (3.13) T_{11} NSKE 5% (3.33) is found to be least effective than all the treatments and is significantly superior over the T_0 control (3.60).

Seven Days After Spraying:The data on the larval population of spotted stem borer on seven days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.40) followed by T_1 Chlorantraniliprole 18.5 SC (0.46), T_{10} Indoxacarb 15.8 EC (0.60), T_3 Thiamethoxam 25 WG (0.66), T_2 Lambda cyhalothrin 2.5% EC (0.80) and T_8 Spinosad 45 SC (1.06). In this T_4Profenophos 50 EC (1.26), T_5 Cypermethrin 10 EC (1.33), T_7*Verticilliumlecani*1.15 WP (1.73), T_6 Neem oil 3% (1.86) T_{11} NSKE 5% (2.13) is found to be least effective than all the treatments and is significantly superior over the T_0 control (3.86).

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Fourteen Days After Spraying: The data on the larval population of spotted stem borer on fourteen days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (1.06) followed by T_1 Chlorantraniliprole 18.5 SC (1.20), T_{10} Indoxacarb 15.8 EC (1.33), T_3 Thiamethoxam 25 WG (1.46), T_2 Lambda cyhalothrin 2.5% EC (1.66) and T_8 Spinosad 45 SC (1.73). In this T_4Profenophos 50 EC (1.80), T_5 Cypermethrin 10 EC (2.26), T_7*Verticilliumlecani*1.15 WP (2.53), T_6 Neem oil 3% (2.66), T_{11} NSKE 5% (2.93) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.20).

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Overall Mean of First Spray: The data on the larval population of spotted stem borer on mean (3^{rd}, 7^{th} and 14^{th} DAS)days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.99) followed by T_1 Chlorantraniliprole 18.5 SC (1.10), T_{10} Indoxacarb 15.8 EC (1.28), T_3 Thiamethoxam 25 WG (1.44), T_2 Lambda

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cyhalothrin 2.5% EC (1.57) and T_8 Spinosad 45 SC (1.70). In this T_4Profenophos 50 EC (1.86), T_5 Cypermethrin 10 EC (2.13), T_7*Verticilliumlecani*1.15 WP (2.39) T_6 Neem oil 3% (2.55) T_{11} NSKE 5% (2.79) is found to be least effective than all the treatments and is significantly superior over the T_0 control (3.88).

Efficacy of *ChilopartellusKharif* 2021 (Second Spray)

Three Days After Spraying: The data on the larval population of spotted stem borer on three days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.60) followed by T_1 Chlorantraniliprole 18.5 SC (0.80), T_{10} Indoxacarb 15.8 EC (0.86), T_3 Thiamethoxam 25 WG (1.06), T_2 Lambda cyhalothrin 2.5% EC (1.20) and T_8 Spinosad 45 SC (1.33). In this T_4Profenophos 50 EC (1.60), T_5 Cypermethrin 10 EC (1.80), T_7*Verticilliumlecani*1.15 WP (2.13), T_6 Neem oil 3% (2.20) T_{11} NSKE 5% (2.40) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.46).

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Seven Days After Spraying: The data on the larval population of spotted stem borer on seven days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.20) followed by T_1 Chlorantraniliprole 18.5 SC (0.26), T_{10} Indoxacarb 15.8 EC (0.40), T_3 Thiamethoxam 25 WG (0.60), T_2 Lambda cyhalothrin 2.5% EC (0.73) and T_8 Spinosad 45 SC (0.93). In this T_4Profenophos 50 EC (1.20), T_5 Cypermethrin 10 EC (1.33), T_7*Verticilliumlecani*1.15 WP (1.46), T_6 Neem oil 3% (1.73) T_{11} NSKE 5% (2.20) is found to be least effective than all the treatments and is significantly superior over the T_0 control (5.00).

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Fourteen Days After Spraying: The data on the larval population of spotted stem borer on fourteen days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.40) followed by T_1 Chlorantraniliprole 18.5 SC (0.53), T_{10} Indoxacarb 15.8 EC (0.60), T_3 Thiamethoxam 25 WG (0.80), T_2 Lambda cyhalothrin 2.5% EC (0.93) and T_8 Spinosad 45 SC (1.06). In this T_4Profenophos 50 EC (1.40), T_5

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Cypermethrin 10 EC (1.53), T_7*Verticilliumlecani*1.15 WP (1.80), T_6 Neem oil 3% (2.00), T_{11} NSKE 5% (2.46) is found to be least effective than all the treatments and is significantly superior over the T_0 control (5.33).

Overall Mean of Second Spray: The data on the larval population of spotted stem borer on mean (3rd, 7th and 14th DAS)days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.40) followed by T_1 Chlorantraniliprole 18.5 SC (0.53), T_{10} Indoxacarb 15.8 EC (0.62), T_3 Thiamethoxam 25 WG (0.82), T_2 Lambda cyhalothrin 2.5% EC (0.95) and T_8 Spinosad 45 SC (1.10). In this T_4Profenophos 50 EC (1.40), T_5 Cypermethrin 10 EC (1.55), T_7*Verticilliumlecani*1.15 WP (1.79) T_6 Neem oil 3% (1.97) T_{11} NSKE 5% (2.35) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.93).

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Efficacy of *ChilopartellusKharif* 2022 (First Spray).

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Three Days After Spraying: The data on the larval population of spotted stem borer on three days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (1.66) followed by T_1 Chlorantraniliprole 18.5 SC (1.73), T_{10} Indoxacarb 15.8 EC (1.80), T_3 Thiamethoxam 25 WG (1.86), T_2 Lambda cyhalothrin 2.5% EC (1.93) and T_8 Spinosad 45 SC (2.00). In this T_4Profenophos 50 EC (2.06), T_5 Cypermethrin 10 EC (2.13), T_7*Verticilliumlecani*1.15 WP (2.20), T_6 Neem oil 3% (2.26) T_{11} NSKE 5% (2.33) is found to be least effective than all the treatments and is significantly superior over the T_0 control (3.86).

Seven Days After Spraying: The data on the larval population of spotted stem borer on seven days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.40) followed by T_1 Chlorantraniliprole 18.5 SC (0.46), T_{10} Indoxacarb 15.8 EC (0.53), T_3 Thiamethoxam 25 WG (0.60), T_2 Lambda cyhalothrin 2.5% EC (0.66) and T_8 Spinosad 45 SC (0.73). In this T_4Profenophos 50 EC (0.86), T_5 Cypermethrin 10 EC (0.93), T_7*Verticilliumlecani*1.15 WP (1.00), T_6 Neem oil 3% (1.06) T_{11} NSKE 5% (1.20) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.00).

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Fourteen Days After Spraying: The data on the larval population of spotted stem borer on fourteen days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.80) followed by T_1 Chlorantraniliprole 18.5 SC (0.86), T_{10} Indoxacarb 15.8 EC (0.93), T_3 Thiamethoxam 25 WG (1.00), T_2 Lambda cyhalothrin 2.5% EC (1.06) and T_8 Spinosad 45 SC (1.13). In this T_4Profenophos 50 EC (1.26), T_5 Cypermethrin 10 EC (1.33), T_7*Verticilliumlecani*1.15 WP (1.40), T_6 Neem oil 3% (1.46), T_{11} NSKE 5% (1.60) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.13).

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Overall Mean of First Spray: The data on the larval population of spotted stem borer on mean (3rd, 7th and 14th DAS)days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.95) followed by T_1 Chlorantraniliprole 18.5 SC (1.01), T_{10} Indoxacarb 15.8 EC (1.08), T_3 Thiamethoxam 25 WG (1.15), T_2 Lambda cyhalothrin 2.5% EC (1.21) and T_8 Spinosad 45 SC (1.28). In this T_4Profenophos 50 EC (1.39), T_5 Cypermethrin 10 EC (1.46), T_7*Verticilliumlecani*1.15 WP (1.53) T_6 Neem oil 3% (1.59) T_{11} NSKE 5% (1.71) is found to be least effective than all the treatments and is significantly superior over the T_0 control (3.99).

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Efficacy of *ChilopartellusKharif* 2022 (Second Spray)

Three Days After Spraying: The data on the larval population of spotted stem borer on three days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.60) followed by T_1 Chlorantraniliprole 18.5 SC (0.66), T_{10} Indoxacarb 15.8 EC (0.73), T_3 Thiamethoxam 25 WG (0.80), T_2 Lambda cyhalothrin 2.5% EC (0.86) and T_8 Spinosad 45 SC (0.93). In this T_4Profenophos 50 EC (1.06), T_5 Cypermethrin 10 EC (1.13), T_7*Verticilliumlecani*1.15 WP (1.20), T_6 Neem oil 3% (1.26) T_{11} NSKE 5% (1.40) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.26).

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Seven Days After Spraying: The data on the larval population of spotted stem borer on seven days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.26) followed by T_1 Chlorantraniliprole 18.5 SC (0.33), T_{10}

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Indoxacarb 15.8 EC (0.40), T_3 Thiamethoxam 25 WG (0.46), T_2 Lambda cyhalothrin 2.5% EC (0.53) and T_8 Spinosad 45 SC (0.60). In this T_4Profenophos 50 EC (0.66), T_5 Cypermethrin 10 EC (0.73), T_7*Verticilliumlecani*1.15 WP (0.80), T_6 Neem oil 3% (0.86) T_{11} NSKE 5% (1.00) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.40).

Fourteen Days After Spraying: The data on the larval population of spotted stem borer on fourteen days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.33) followed by T_1 Chlorantraniliprole 18.5 SC (0.40), T_{10} Indoxacarb 15.8 EC (0.46), T_3 Thiamethoxam 25 WG (0.53), T_2 Lambda cyhalothrin 2.5% EC (0.60) and T_8 Spinosad 45 SC (0.66). In this T_4Profenophos 50 EC (0.80), T_5 Cypermethrin 10 EC (0.86), T_7*Verticilliumlecani*1.15 WP (0.93), T_6 Neem oil 3% (1.00), T_{11} NSKE 5% (1.13) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.56).

Overall Mean of Second Spray: The data on the larval population of spotted stem borer on mean (3rd, 7th and 14th DAS)days after spray revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.39) followed by T_1 Chlorantraniliprole 18.5 SC (0.46), T_{10} Indoxacarb 15.8 EC (0.53), T_3 Thiamethoxam 25 WG (0.59), T_2 Lambda cyhalothrin 2.5% EC (0.66) and T_8 Spinosad 45 SC (0.73). In this T_4Profenophos 50 EC (0.84), T_5 Cypermethrin 10 EC (0.90), T_7*Verticilliumlecani*1.15 WP (0.97) T_6 Neem oil 3% (1.04) T_{11} NSKE 5% (1.17) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.37).

Pooled mean: The data on the larval population of spotted stem borer on pooled mean revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.68) followed by T_1 Chlorantraniliprole 18.5 SC (0.77), T_{10} Indoxacarb 15.8 EC (0.87), T_3 Thiamethoxam 25 WG (1.00), T_2 Lambda cyhalothrin 2.5% EC (1.09) and T_8 Spinosad 45 SC (1.20). In this T_4Profenophos 50 EC (1.37), T_5 Cypermethrin 10 EC (1.51), T_7*Verticilliumlecani*1.15 WP (1.67) T_6 Neem oil 3% (1.78) T_{11} NSKE 5% (2.00) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.29).

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Table: 1 Efficacy against *ChilopartellusKharif*-2021

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Treatments		Larval population on number basis/5 plants								Overall Mean
		One day before spray	After First Spray				After Second Spray			
			3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean
T_1	Chlorantraniprole 18.5 % SC	3.20	1.66^{ij}	0.46^{f}	1.20^{f}	1.10^{hi}	0.80^{hi}	0.26^{i}	0.53^{gh}	0.53^{hi}	0.81^{g}
T_2	Lambda Cyhalothrin 5% EC	3.06	2.26^{fg}	0.80^{ef}	1.66^{de}	1.57^{efg}	1.20^{fg}	0.73^{fg}	0.93^{f}	0.95^{g}	1.26^{efg}
T_3	Thiamethoxam 25% WG	3.46	2.20^{gh}	0.66^{ef}	1.46^{def}	1.44^{fgh}	1.06^{fgh}	0.60^{gh}	0.80^{fg}	0.82^{gh}	1.13^{efg}
T_4	Profenophos 50% EC	3.53	2.53^{ef}	1.26^{d}	1.80^{d}	1.86^{de}	1.60^{de}	1.20^{de}	1.40^{e}	1.40^{ef}	1.63^{cdef}
T_5	Cypermethrin 10% EC	3.46	2.80^{de}	1.33^{cd}	2.26^{c}	2.13^{cd}	1.80^{cd}	1.33^{d}	1.53^{de}	1.55^{de}	1.84^{bcde}
T_6	Neem oil 3%	3.53	3.13^{bc}	1.86^{b}	2.66^{bc}	2.55^{b}	2.20^{b}	1.73^{c}	2.00^{c}	1.97^{c}	2.26^{bc}
T_7	*Verticilliumlecani*1.15 % WP	3.46	2.93^{cd}	1.73^{bc}	2.53^{bc}	2.39^{bc}	2.13^{bc}	1.46^{cd}	1.80^{cd}	1.79^{cd}	2.09^{bcd}

T_8	Spinosad 45% SC	3.06	2.33^{fg}	1.06^{de}	1.73^{de}	1.70^{ef}	1.33^{ef}	0.93^{ef}	1.06^{f}	1.10^{fg}	1.40^{defg}
T_9	Emamectin benzoate 5 % SG	3.26	1.53^{j}	0.40^{f}	1.06^{f}	0.99^{i}	0.60^{i}	0.20^{i}	0.40^{h}	0.40^{i}	0.69^{g}
T_{10}	Indoxacarb 15.8% EC	3.53	1.93^{hi}	0.60^{f}	1.33^{ef}	1.28^{ghi}	0.86^{ghi}	0.40^{hi}	0.60^{gh}	0.62^{hi}	0.95^{fg}
T_{11}	NSKE 5 %	3.86	3.33^{ab}	2.13^{b}	2.93^{b}	2.79^{b}	2.40^{b}	2.20^{b}	2.46^{b}	2.35^{b}	2.57^{b}
T_0	Control	3.20	3.60^{a}	3.86^{a}	4.20^{a}	3.88^{a}	4.46^{a}	5.00^{a}	5.33^{a}	4.93^{a}	4.40^{a}
F-test		**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Ed (±)		1.68	0.13	0.20	0.19	0.20	0.78	0.13	0.73	0.15	0.27
C.D. (P=0.05)		-	0.27	0.42	0.40	0.41	0.34	0.28	0.32	0.31	0.73

DBS- Day before Spraying, DAS- Day after Spraying, NS- Non significant, S- Significant

Table: 2 Efficacy against *ChilopartellusKharif*-2022

Treatments		Larval population on number basis/5 plants								Overall Mean	Pooled Mean
		One day before spray	After First Spray				After Second Spray				
			3 DAS	7 DAS	14 DAS	Mean	3 DAS	7 DAS	14 DAS	Mean	
T_1	Chlorantraniprole 18.5 % SC	3.80	1.73^{fg}	0.46^{bc}	0.86^{gh}	1.01^{g}	0.66^{gh}	0.33^{ij}	0.40^{hi}	0.46^{hi}	0.73^{fg}	0.77^{g}
T_2	Lambda Cyhalothrin 5% EC	3.93	1.93^{cdefg}	0.66^{efg}	1.06^{efg}	1.21^{defg}	0.86^{efg}	0.53^{fgh}	0.60^{fg}	0.66^{fg}	0.93^{cdefg}	1.09^{efg}
T_3	Thiamethoxam 25% WG	3.86	1.86^{defg}	0.60^{fgh}	1.00^{fgh}	1.15^{efg}	0.80^{fgh}	0.46^{ghi}	0.53^{fgh}	0.59^{fgh}	0.87^{defg}	1.00^{efg}
T_4	Profenophos 50% EC	4.00	2.06^{bcdef}	0.86^{cde}	1.26^{cde}	1.39^{bcdef}	1.06^{cde}	0.66^{def}	0.80^{de}	0.84^{de}	1.11^{bcdef}	1.37^{cdef}
T_5	Cypermethrin 10% EC	4.06	2.13^{bcde}	0.93^{cd}	1.33^{cd}	1.46^{bcde}	1.13^{cd}	0.73^{cde}	0.86^{cd}	0.90^{cd}	1.18^{bcde}	1.51^{bcde}
T_6	Neem oil 3%	4.20	2.26^{bc}	1.06^{bc}	1.46^{bc}	1.59^{bc}	1.26^{bc}	0.86^{bc}	1.00^{bc}	1.04^{bc}	1.31^{bc}	1.78^{bc}
T_7	*Verticilliumlecani*1.15 % WP	4.13	2.20^{bcd}	1.00^{bc}	1.40^{bc}	1.53^{bcd}	1.20^{bc}	0.80^{cd}	0.93^{cd}	0.97^{cd}	1.25^{bcd}	1.67^{bcd}

T_8	Spinosad 45% SC	4.00	2.00^{bcdefg}	0.73^{def}	1.13^{def}	1.28^{cdefg}	0.93^{def}	0.60^{efg}	0.66^{ef}	0.73^{ef}	1.00^{cdefg}	1.20^{defg}
T_9	Emamectin benzoate 5 % SG	3.66	1.66^{g}	0.40^{h}	0.80^{h}	0.95^{g}	0.60^{h}	0.26^{j}	0.33^{i}	0.39^{i}	0.67^{g}	0.68^{g}
T_{10}	Indoxacarb 15.8% EC	3.86	1.80^{efg}	0.53^{fgh}	0.93^{fgh}	1.08^{fg}	0.73^{fgh}	0.40^{hij}	0.46^{ghi}	0.53^{ghi}	0.80^{efg}	0.87^{fg}
T_{11}	NSKE 5 %	4.26	2.33^{b}	1.20^{b}	1.60^{b}	1.71^{b}	1.40^{b}	1.00^{b}	1.13^{b}	1.17^{b}	1.44^{b}	2.00^{b}
T_0	Control	3.73	3.86^{a}	4.00^{a}	4.13^{a}	3.99^{a}	4.26^{a}	4.40^{a}	4.56^{a}	4.37^{a}	4.18^{a}	4.29^{a}
F-test		**NS**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Ed (±)		0.20	0.16	0.10	0.11	0.17	0.10	0.08	0.09	0.06	0.15	0.25
C.D. (P=0.05)		-	0.34	0.20	0.23	0.35	0.21	0.18	0.19	0.14	0.41	0.56

DBS- Day before Spraying, DAS- Day after Spraying, NS- Non significant, S- Significant

4. DISCUSSION

Overall (First and Second Spray) *Chilopartellus*(*Kharif* 2021)

The data on the larval population of spotted stem borer on overall mean (first and second spray)revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.69) followed by T_1 Chlorantraniliprole 18.5 SC (0.81), T_{10} Indoxacarb 15.8 EC (0.95), T_3 Thiamethoxam 25 WG (1.13), T_2 Lambda cyhalothrin 2.5% EC (1.26) and T_8 Spinosad 45 SC (1.40). In this T_4Profenophos 50 EC (1.63), T_5 Cypermethrin 10 EC (1.84), T_7*Verticilliumlecani*1.15 WP (2.09) T_6 Neem oil 3% (2.26) T_{11} NSKE 5% (2.57) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.40).

Among all the treatments, Emamectin benzoate 5 % SG was found to be most effective in managing the larval population of spotted stem borer. The values obtained in the first and second spray were (0.99) and (0.40). These results are supported by **Rathod *et al*., (2020).** Chlorantraniliprole 18.5% SC was also found to be very effective in reducing the larval population of spotted stem borer. The values obtained in the first and second spray were (1.10) and (0.53). The same results were observed by **Arunkumara*et al*., (2017), Devananda *et al*., (2018).** The application of Indoxacarb 15.8% EC reduced the larval population of spotted stem borer. Where the observations of first and second sprays obtained were (1.28) and (0.62). These results are supported by **Prakash *et al*., (2017)** and **Rathod *et al*., (2020).** The efficacy of Thiamethoxam 25% WG on spotted stem borer in first and second spray were (1.44) and (0.82). These results are as per the findings of **Joshi *et al*., (2019).**

The next best treatment was found to be Lambda Cyhalothrin 5% EC in which the efficacy values of first and second spray were (1.57) and (0.95) respectively to the similar findings of **Prakash *et al*., (2017).** The next best treatment was found to be Spinosad 45% SC in which the efficacy values of first and second spray were (1.70) and (1.10) respectively; these results were supported by **Joshi *et al*., (2019)**and **Malar *et al*., (2018).** The next effective treatment was found to beProfenophos 50% EC in which efficacy values of first and second sprays were (1.86) and (1.40) respectively; these results were supported by **Devananda *et al*., (2018).** The efficacy of Cypermethrin 10% EC on spotted stem borer in first and second spray were (2.13) and (1.55). These results are as per the findings of **Ahmad *et al*., (2002), Bhat and Baba (2007) and Dinesh *et al*., (2018).**

Overall (First and Second Spray) *Chilopartellus*(*Kharif* 2022)

The data on the larval population of spotted stem borer on overall mean (first and second spray) revealed that all treatments were significantly superior over control. Among the treatments lowest larval population of spotted stem borer was recorded in T_9Emamectin benzoate 5 SG (0.67) followed by T_1 Chlorantraniliprole 18.5 SC (0.73), T_{10} Indoxacarb 15.8 EC (0.80), T_3 Thiamethoxam 25 WG (0.87), T_2 Lambda cyhalothrin 2.5% EC (0.93) and T_8 Spinosad 45 SC (1.00). In this T_4Profenophos 50 EC (1.11), T_5 Cypermethrin 10 EC (1.18), T_7*Verticilliumlecani*1.15 WP (1.25) T_6 Neem oil 3% (1.31) T_{11} NSKE 5% (1.44) is found to be least effective than all the treatments and is significantly superior over the T_0 control (4.18).

Among all the treatments, Emamectin benzoate 5 % SG was found to be most effective in managing the larval population of spotted stem borer. The values obtained in the first and second spray were (0.95) and (0.39). These results are supported by **Rathod *et al*., (2020).** Chlorantraniliprole 18.5% SC was also found to be very effective in reducing the larval population of spotted stem borer. The values obtained in the first and second spray were (1.01) and (0.46). The same results were observed by **Kumar *et al*., (2017) and Kumar and Jindal (2015).** The application of Indoxacarb 15.8% EC reduced the larval population of spotted stem borer. Where the observations of first and second sprays obtained were (1.08) and (0.53). These results are supported by **Devananda *et al*., (2018) and Prakash *et al*., (2017).** The efficacy of Thiamethoxam 25% WG on spotted stem borer in first and second spray were (1.15) and (0.59). These results are as per the findings of **Joshi *et al*., (2019).**

The next best treatment was found to be Lambda Cyhalothrin 5% EC in which the efficacy values of first and second spray were (1.21) and (0.66) respectively to the similar findings of **Prakash *et al*., (2017).** The next best treatment was found to be Spinosad 45% SC in which the efficacy values of first and second spray were (1.28) and (0.73) respectively; these results were supported by **Devananda *et al*., (2018) and Kumar *et al*., (2017).**The next effective treatment was found to beProfenophos 50% EC in which efficacy values of first and second sprays were (1.39) and (0.84) respectively; these results were supported **Justin and Preetha (2014).** The efficacy of Cypermethrin 10% EC on spotted stem borer in first and second spray were (1.46) and (0.90). These results are as per the findings of **Babu and Kumar (2022), Reddy and Kumar (2021) and Prakash *et al*., (2017).**

CONCLUSION

From the current investigation, the findings indicate that Emamectin benzoate 5% SG succeeded by Chlorantraniliprole 18.5% SC and Indoxacarb 15.8% EC, emerge as the most efficacious treatments against the maize spotted stem borer. These treatments not only resulted in the highest yield but also demonstrated the most favourable Cost-Benefit ratio when compared to alternative treatments. Thiamethoxam 25% WG, Lambda Cyhalothrin 5% EC, Spinosad 45% SC, and Profenophos 50% EC exhibited moderate efficacy in the management of the spotted stem borer. Conversely, Cypermethrin 10% EC, *Verticilliumlecani*1.15 % WP, Neem oil 3%, and NSKE 5% were identified as the least effective in controlling all maize pests. Based on these findings, it is strongly recommended to integrate the use of effective insecticides into existing Integrated Pest Management programs. Emphasis should be placed on preventing issues such as insecticide resistance and pest resurgence. The inclusion of botanical substances is crucial in Integrated Pest Management as it helps mitigate the indiscriminate use of pesticides, minimizing environmental harm, and preserving the impact on beneficial insects.

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